SMALL AIRCRAFT TRANSPORTATION SYSTEM PROGRAM

PROGRAM PLAN

STRAWMAN

CONTENTS

1.0 Introduction and Program Overview

This plan provides the description of the program-level management of the NASA Small Aircraft Transportation (SATS) Program and is the controlling document for program content and organization. The primary purpose of the plan is to establish the Program objectives and performance goals; Program requirements, management, and implementing organizations; and Program resources, schedules, and controls. This Program plan is approved by the Associate Administrator of the Office of Aerospace Technology (OAT) and concurred upon by the Directors of the participating research centers. This concurrence represents commitments to provide the workforce and facilities necessary to accomplish program goals consistent with the specified funding plans. This plan will be updated appropriately to reflect program progress, programmatic changes, and strategic redirection.

1.1 BACKGROUND

Transportation in the U.S., long the underpinning of economic strength, is losing speed, accessibility, flexibility, and efficiency. This nation's investments to reduce highway and hub-and-spoke congestion and delays are reaching the point of diminishing returns, and transportation demand continues to soar. As time becomes the "scarce commodity" of the information age, demand for aviation transportation will outpace the capacity provided by the system of today's hub-and-spoke airports. Thus, early in the 21st century, when speed is at a premium, the nation's doorstep-to-destination travel speeds will be in decline. Delays in the hub-and-spoke and aging highway systems may limit economic expansion in the information age to fewer well-connected regions and communities. Fortunately, most of the U.S. population lives within a 30-minute drive of over 5,000 public-use landing facilities. This infrastructure is an untapped national resource for mobility.

Community vitality and economic opportunity increasingly depends on access to rapid point-to-point transportation, in particular air transportation. Airports are magnets for new businesses, new jobs, new community revenues, and new standards of living. Today, the few communities with airports capable of handling smaller turbine-powered aircraft in near all-weather conditions create significant economic benefits compared to communities that are not served by such landing facilities. The NASA-led SATS Program is a five-year research effort to develop the key technologies needed for an initial set of new operating capabilities. The program would culminate in a joint NASA/FAA proof-of-concept demonstration of these new operating capabilities. The SATS Program is linked to the premise that reduced inter-city travel times is proportional to accessibility. The five-year program objective is to demonstrate key airborne technologies for precise guided accessibility in small aircraft[1] to virtually any touchdown zone at small airports[2]. These airports shall not require air traffic control towers and the airspace shall not require radar surveillance for air traffic services.

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[1] FAA FAR Part 23 Certification, compliant to certitude standards in Advisory Circulars 23.1309 and 23.1311 for aircraft of less than 6,000 lbs. Gross Takeoff Weight (GTW) or 12,500 GTW; operated under FAR Part 91 or 135 regulations, with pilot training under FAR Part 141 including FAA approved waivers for the AGATE Unified Instrument-Private Pilot curriculum and Practical Test Standard

[2] General Aviation, Reliever, Regional, or Utility Landing Facilities of between 3,000 and 5,000 feet runway length or longer, without FAA FAR Part 139 regulatory requirements.

1.2 Definitions

Small: The technologies targeted for development are aimed at smaller aircraft used for personal and business transportation missions within the infrastructure of smaller airports throughout the nation. These missions include transportation of goods and travel by individuals, families, or groups of business associates. Consequently the aircraft are of similar size to typical automobiles and vans used for non-commercial ground transportation. They may be used for on demand, unscheduled air-taxi transportation of these same user types. Various forms of shared ownership and usage will likely be a most common means of use. While the aircraft are not specifically designed for air carrier use, the targeted technologies would provide benefits to commuter and major air carrier operations in the hub-and-spoke system as well. For FAA regulatory purposes, SATS technologies are targeted toward aircraft with a maximum take off weight (MTOW) less than12,500 pounds (i.e., FAA small aircraft category).

Aircraft: The strategy for development of airborne technologies focuses initially on fixed-wing airplane applications; however, the technologies created are also applicable to operational improvements for vertical take-off and landing aircraft. These technologies would enable near all-weather operations by new generations of such aircraft at virtually any landing facility in the nation. Near all-weather means operational reliability in instrument meteorological conditions except those classified as severe or hazardous (i.e., severe icing, severe turbulence, thunder storm activity, etc).

Transportation: The technology investments are selected and prioritized for the purpose of transportation of people, goods, and services. Even so, the technologies would likely have favorable effects on safety, cost, and accessibility in recreational or other non-transportation commercial uses. The aircraft will have the altitude and speed performance, as well as the weather avoidance and toleration systems, to enable safe and reliable operations with high availability (similar to or better than today's air carrier reliability).

System: In addition to technologies for the aircraft, SATS strategies are conceived to affect the nature of aviation operational capabilities for airports, airspace, and air traffic and commercial services. The SATS vision encompasses inter-modal connectivity between public and private, air and ground modes of travel. In concept, the SATS vision integrates the National Airspace System with the interstate highway system, intra-city rail transit systems, and hub-and-spoke airports. The strategy focuses on airborne technologies that expand the use of underutilized airports (those without precision instrument approaches) as well as underutilized airspace for transportation use (such as the low-altitude, non-radar airspace below 6,000 feet and the enroute structure below 18,000 feet).

1.3 Current Status

The SATS Program was initiated in October of 2001 with a $9 million budget for FY01 and specific objectives mandated by in NASA's FY01 appropriations bill (PL 106-377) regarding planning and reporting. Specifically, the reference Congressional Conference Report (House Report 106-988) identified four operating capabilities that NASA and the FAA were to develop during the 5 year program. The four operating capabilities identified were: (1) high-volume operations at airports without control towers or terminal radar facilities, (2) lower adverse weather landing minimums at minimally equipped landing facilities, (3) integration of SATS aircraft into a higher en route capacity air traffic control system with complex flows and slower aircraft, (4) improved single-pilot ability to function competently in complex airspace in an evolving NAS. The bill also recognized that the proposed $69 million program budget is insufficient to conduct operational evaluations of all four operating capabilities. Therefore, this program plan currently addresses only those activities for which there are sufficient funding, namely conducting proof-of-concept demonstrations of three of the four operating capabilities. It is anticipated that the current program will be followed by a FAA-led activity focused on an operational evaluation of SATS. Both NASA and the FAA are developing augmentation plans for FY02 and beyond which will address the remaining operating capability and provide the FAA with the appropriate level of funding to lead the operational evaluations of the SATS concept.

For the five-year, NASA-led, $69 million program, the operating capabilities that will be demonstrated in FY05 are defined below.

<u>Higher Volume Operations at Non-Towered/Non-Radar Airports.</u> Simultaneous operations by multiple aircraft in non-radar airspace at and around small non-towered airports can create accessibility to virtually any landing site in the nation in near all-weather conditions. This SATS operating capability has the potential to create an alternative to growth of NAS and can provide a lower infrastructure cost alternative.

<u>Lower Landing Minimums at Minimally Equipped Landing Facilities</u> Highway in the Sky graphical flightpath guidance with artificial vision can create near all-weather access to any touchdown zone at any landing facility while avoiding land acquisition and approach lighting costs, as well as ground-based precision guidance systems such as ILS.

<u>Flight Systems for Improved Total System Performance.</u> Human-centered automation will provide intuitive, easy to follow flight path guidance superimposed on a depiction of the outside world. Software enabled flight controls and flight planning will increase single-crew operational safety and mission reliability to two-crew levels. This SATS operating capability can lead to higher levels of safety and throughput for increasing numbers of users in the NAS.

2.0 Program Objectives

[This paragraph will contain the SATS Program's relation to agencie's goals which are currently being reformulated.]

2.1 SATS GOAL

The overall program goal is to conduct a proof-of-concept that provides the technical, policy, and economic basis for national investment decisions to develop a small aircraft transportation system by demonstrating key airborne technologies for precise guided accessibility in small aircraft at non-towered airports and in non-radar airspace. The program will achieve this goal through the following objectives:

- Develop and integrate key technologies that enable new operating capabilities
- Conduct simulation and flight test proofs-of-concept of the new operating capabilities
- Assess socio-economic and environmental viability of SATS

2.2 PERFORMANCE OBJECTIVES

[This section still under development.]

2.3 *PROGRAM SUCCESS CRITERIA*

Success of the SATS Program will be measured against the objective metrics for the three operating capabilities (potential metrics are listed below) and the Program's ability to deliver the necessary technologies.

Higher Volume Operations at Non-Towered/Non-Radar Airports. The objective metrics for this capability includes a minimum success requirement of at least two simultaneous aircraft operations (arrival and/or departure) in Instrument Meteorological Conditions in the terminal area.

Lower Landing Minimums at Minimally Equipped Landing Facilities. The objective metrics for this capability includes a minimum success requirement for a reduction of approach minimums for cloud and visibility of 200 feet and 1/2 mile and better than existing approach surface gradients of 50:1. The stretch success requirement is for better than 1/4-mile visibility and better than 20:1 approach surface gradients.

Flight Systems for Improved Total System Performance. The objective metrics for this capability includes a minimum success requirement of improving Total System Performance (TSP) for a single-crew-operated aircraft to levels at least 25-percent better than that of a two-crew-operated aircraft. The stretch success requirement is for a 50-percent or better TSP by a single-crew-operated aircraft, operated in IMC to the minimums and separation requirements of the other operating capabilities.

3.0 Customer Definition

Strong and effective partnerships will play a pivotal role in developing and deploying SATS technologies for the nation. These partnerships must include NASA, FAA, and other federal agencies and state governments as required, and the public and private sectors, including universities. These partnerships will enable the national development and deployment of standards for SATS system analysis, State Aviation System Plans, Airport Master Plans, and regional transportation system planning. The existing instruments for such partnerships include the National Governors Association/Department of Commerce U.S. Innovation Partnership, along with the lieutenant governors' Aerospace States Association alliance.

NASA is in a unique position to organize and coordinate the nucleus of a national partnership for SATS technologies.

4.0 Program Authority and Management Structure

4.1 *ORGANIZATION*

4.2 *RESPONSIBILITIES*

5.0 Program Requirements

5.1 *PROGRAM ELEMENTS*

The technical approach for the SATS research program includes laboratory, simulation, and flight experiments that integrate the enabling technologies discussed below in order to create and demonstrate the three SATS operating capabilities. The planned experiments will produce data on the ability of the SATS technologies to meet requirements for aircraft separation standards in the targeted airspace, approach surface gradient requirements, allocation of functions in the client-server architecture, the limits of human-aided automation in all aspects of flight control including separation and sequencing operations, and the issues associated with certification of the technologies. The SATS Program products will include the design guidelines, systems standards, and identification of certification issues for the enabling technologies and operating capabilities.

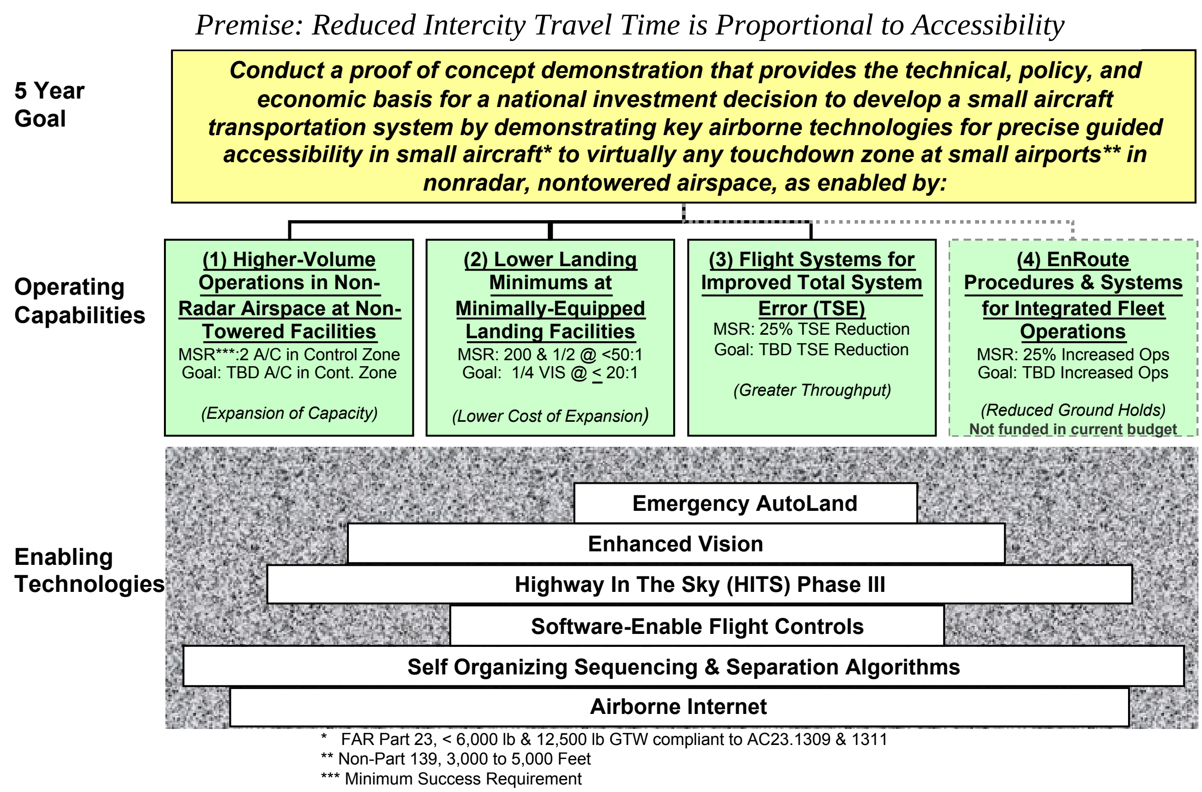

Figure 5.1 Relationship of technologies to operating capabilities.

5.1.1 Virtual Visual Meteorological Conditions (VVMC)

[*Note, the name of this project is likely to change. The name VVMC implies exclusive reliance on display technology to produce a literal recreation of a visual flight environment. The focus of this project is much broader than literal, visual displays and includes integrated pictorial displays (tactical, and strategic), active flight controls, command guidance, and other flight-deck technologies that allow a single pilot to operate from take-off to touchdown in low-visibility conditions from otherwise day VFR runways with significantly enhanced safety and reduced training requirements and workload compared to current single pilot IFR operations.*]

Develop and demonstrate integrated, visibility independent operational procedures, flight deck functions, and enabling technologies that permit a single, low-time pilot to safely operate an airplane at virtually all runways in nearly all weather conditions. Top-level, functional requirements to enable these operational capabilities include the following: high-integrity, precision guidance appropriate to phase of flight including approach, touchdown and roll-out; air and ground obstacle (e.g. traffic, terrain, obstructions, weather, wildlife) detection and avoidance; high-level, high-integrity automation to manage pilot workload and provide an ability to prevent any isolated error or fault (human and automation) from creating a hazardous situation. VVMC will include assessment of certification issues and requirements as well as realistic cost estimates and constraints for proposed procedures, functions, and technologies.

Key sub-elements of VVMC are:

- Visibility Independent Flight Rules (VIFR): To reduce piloting complexity and corresponding training requirements, SATS will develop an integrated set of operational procedures and flight rules that are employed independent of external visibility. These procedures and rules, developed in conjunction with the High-Density Operations project and flight-deck design activities will enable low-time pilots to conduct safe, high-capacity operations in nearly all weather conditions at minimally equipped airports in towerless, radarless airspace. The VVMC portion of the SATS program will lead development of VIFR required for a single airplane independent of visibility while the High-Density Operations project will lead development of procedures that facilitate high-volume, multi-airplane operations.
- Software-Enabled Control Automation: SATS research will integrate simplified manual flight control response types (e.g. attitude or velocity-vector control), flight-envelope protection features (e.g. stall prevention, bank-angle limiting), autopilot functions, propulsion control, and state-of-the-art pilot interface technologies (control inceptors and displays). The objective of this task is to reduce the complexity of pilot actions required to safely and accurately comply with complex, 4-D flight clearances (i.e. required position and time constraints) and to exploit the full performance and safe maneuvering capabilities of a small aircraft. An emergency autoland function will be evaluated and demonstrated as part of the software-based controls task. This autoland function will provide failsafe recovery of the aircraft and occupants in the event of pilot incapacitation.
- 4-D Flight Management and Planning System: The VVMC project will develop algorithms that generate planned and active 4-D flightpaths based on airplane performance and maneuvering limits; pilot intentions and preferences; ATM constraints; and dynamic approach procedures. These algorithms will provide the necessary information to command control automation functions and pathway displays such as the AGATE Phase II HITS display and to generate alternative flight plans should the integrated information and decision support system determine that the active flight plan is no longer feasible or desirable.
- Integrated Information and Decision Support System: The IIDSS will process and integrate data from various sources such as on-board sensors, databases, and data-link systems and will provide the pilot with an appropriately prioritized and presented assessment of the current status of the flight such as eminent hazards to safe flight (e.g. obstruction on runway during short final), emerging hazards to safe flight (e.g. hazardous weather developing along the active flight plan), current and projected traffic conflicts, and airplane system status. The IIDSS in conjunction with the 4D Flight-Management Planning system will be capable of autonomously generating constructive flight-plan modifications during normal and pre-defined abnormal situations (e.g. unforecast hazardous weather, engine failure). These proposed modifications will be presented to the pilot in a manner that facilitates rapid comprehension, alteration, and implementation by the pilot.

Major experiments expected to be performed under the VVMC project include the following examples in the 2003-04 timeframe. Evaluate in ground simulation and flight-test varying levels of control automation (e.g. envelope protection, velocity vector control, and fully automatic flight control) with the goal of determining the impact on pilot training, safety, workload, utility, and life cycle costs. In conjunction with these control automation-levels, integrated primary flight display formats and command guidance symbologies will be evaluated including flight directors, velocity vector guidance including predictive elements, and pathway displays. Application of synthetic vision display formats ranging from literal, photo-realistic displays to idealized, skeletal presentations will be evaluated during low-visibility landings. Cockpit traffic displays including perspective and horizontal situation formats with predictive information will be evaluated to assess the pilot's awareness of traffic and the ability to self-separate and cooperatively sequence in the terminal area. Command input technologies including graphical interfaces, voice command, and tactile devices will be integrated and evaluated as appropriate.

5.1.2 High-Density Operations

New algorithms and procedures will be required to support SATS capabilities. Operations in low-visibility conditions with multiple aircraft in non-tower/non-radar airspace will require airborne technology support for sequencing, separation, and runway approach guidance. This element will develop concepts, algorithms, and procedures that enable a safe airspace with the following functional capabilities:

- Collaborative decision making between vehicles for sequencing and separation, conflict detection & resolution, and hazardous weather avoidance
- Approach paths that dynamically account for known weather, traffic, terrain, NOTAMs, and airspace restrictions
- Flight Information Services (FIS) and distributed Air Traffic Management (ATM) functions required to support the above capabilities and to minimize the need for voice communication.

Key research areas in this element are:

- Self-Separation (SS) Algorithms/Procedures: Develop algorithms and procedures that enable safe self-separation of aircraft in crowded airspace with minimal human intervention and taking into account likely non-normal conditions. The goal is to identify possible conflicts sufficiently ahead of time to separate aircraft with efficient course/speed deviations.
- Conflict Detection & Resolution (CD&R) Algorithms/Procedures: Develop algorithms to detect and resolve conflicts between two or more aircraft's which find themselves in conflict due to external factors and/or non-normal conditions.
- Dynamic Approach Path (DAP) Algorithms/Procedures: Develop algorithms and procedures that provide efficient and safe real-time approach path guidance and sequencing to runways employing energy management procedures and accounting for other traffic, local weather conditions, terrain, airspace restrictions, and likely non-normal conditions.
- Flight Operations, Requirements, and Airspace Design: Develop the operational concepts and requirements for vehicles with the above capabilities. The requirements and supporting analyses will provide the framework for the development of SS, CD&R, and DAP algorithms/procedures and the integration with future NAS ATM and FIS capabilities.

A combination of formal methods analyses, simulations, and experiments will be developed to specify, design, test, and validate the algorithms and to estimate the upper-limit traffic capacity enabled by these algorithms at selected airports. Algorithms being developed by academia, industry, FAA, and other NASA programs will be investigated in addition to exploring new and innovative approaches.

Experiments will be conducted to validate the simulation and analyses in realistic environments. The results of these experiments will support downselection of the algorithms/procedures and provide preliminary safety assessment data. It is expected that experiments to test the Conflict Detection & Resolution (CD&R) algorithms for multiple (2+) aircraft will be executed under different trajectory geometries (e.g. headings, turns, level-flight, climbing, descending) and likely emergency procedures to measure the time and distance between targets at conflict detection, blind spots/areas, time to resolution after conflict detection, and pilots subjective assessment of the resolution maneuvers.

Experiments to test 4-D dynamic approach paths and sequencing algorithms will include scenarios with arbitrary headings/altitudes, likely emergency and non-normal conditions (e.g. go-around/missed-approach, engine-out) to measure approach path generation/modification times, separation between aircraft, pilot workload & situational awareness, and the pilots' subjective assessment of sequencing and approach paths. Pilot-in-the-loop ground simulations will be used to test algorithms and procedures in a very high-density conditions and/or in complex dangerous scenarios.

The research products to be developed will efficiently manage aircraft-to-aircraft interactions in a crowded airspace, thus reducing the pilots' workload. By providing guidance and tools for collaborative decision making during complex multiple aircraft operations, including likely non-normal situations, safety will be improved by increasing the pilots' situational awareness while maintaining an appropriate level of workload.

5.1.3 Technology Integration and Proofs-of-Concept

The showcase demonstrations planned for the second-half of FY05 will include both presentations of research results and actual flight demonstrations illustrating the SATS concept. Stakeholders will have an opportunity to experience the SATS concept first-hand and listen to the results of the analyses that quantify the costs and benefits of the system. The scope of the showcase demonstrations will be highly dependent on the leveraging of resources and participation by industry, state, and university partners. It is expected that at least two states or regional organizations will participate in the program enabling a variety of inter-city and interstate travel scenarios to be flight demonstrated. The systems architecture for the flight demonstrations will be developed in partnership with the alliance and the FAA and will attempt to incorporate as many VVMC and High-Density Ops technologies as possible while maintaining the overall safety of the demonstrations.

In order to enable the demonstrations it will be necessary to have in place what the program calls the “Airborne Internet.” SATS will leverage open standards and protocols for a client-server network system architecture that are in development in the telecommunications industry. SATS research will focus on defining the functional allocations between clients and servers for all navigation, communications, and surveillance information necessary for aircraft operations including sequencing, separation, and conflict resolution.

- Define requirements for the SATS Airborne Internet architecture based on open standards and protocols including:
  - Requirements for a network management system
  - Communications management system for integrating multiple CNS datalinks and sensors
- Provide necessary communications/network datalink capability for SATS proof-of-concept

5.1.4 Program Integration

The Program Integration Element of the SATS program will be responsible for several activities and projects. These include program and business management, metric assessments, education and outreach, and systems studies not directly supporting the 2005 proof-of-concept or technology down-selects.

5.1.4.1 *Program Operations*

The program operations element performs the program and business management functions for the SATS Program management functions include the creation, review, and tracking of the program operations milestones along with standard program control activities (resource allocation, tracking and problem resolution etc.). Other responsibilities include required periodic and ad-hoc reporting to senior management at LaRC and NASA HQ. The business management function interfaces with the LaRC Business Management Functions to ensure coordination of Program and Alliance activities, i.e., security, logistics, data control and documentation, procurement, and legal. The Alliance coordination activity requires oversight, monitoring, and control of the business vehicle used for the SATS Alliance. Further tasks include facilitation and resolution of issues and challenges, which arise during operations of a public private partnership.

5.1.4.2 *Integrated System Assessment*

The SATS Program integrated system assessment and metrics management process will include a systems engineering-based modeling and analysis effort. Progress toward the goal of reduced inter-city travel time will be measured using a matrix of transportation missions encompassing representative origin-destination sets, mission purposes, and transportation modes. The proposed metric for benchmarking and analysis is [(trip*mph)/cost]. A trip is a person, group of persons, package(s), or service making a defined trip in the matrix. The mph or speed term is computed based on the doorstep to destination time and great circle distance traveled, including intermodal time requirements. The cost includes vehicle and infrastructure costs as well as the cost or value of time. The metric will be benchmarked using existing modes of travel for trips in the mission matrix. This benchmark will include the doorstep-to-destination inter-city travel times as well as costs for travel in the matrix. In addition to the time reduction goal, a cost goal will be set for travel in the matrix. That cost goal will include the cost of the vehicle, training, infrastructure and operations. The cost goal will be set at an aggressive level as a means of forcing technology investment decisions through a rigorous decision-making process. Technologies will be forced to buy their way into the vehicle or the system based on their ability to meet the cost metric.

5.1.4.3 *Public Outreach and Education*

In order to enable a national decision to develop SATS a significant national public education challenge must be met. In an historical context, the public education challenge for SATS is similar to the challenges the nation faced in the development of the interstate highway system and even for the hub-and-spoke system. Public comprehension of the potential for personal and societal benefits that accrue to SATS transportation capabilities will accelerate public policy funding alignment to support deployment of SATS. Currently a national public education policy does not exist to raise public awareness of benefits of SATS. This element will develop a long-term strategy for public education, awareness, and outreach that will impact the decision makers, policy makers, and future users of the SATS.

5.1.4.4 *Systems Engineering Oversight*

To be successful, the SATS Program will have to focus on specific technology solutions quickly. This will require an accurate understanding of the system requirements for the operating capabilities cited in section 2.2.In order to achieve this level of understanding the Program will take a systems engineering approach to the development of the detailed Project plans. This element will oversee and facilitate the development of operational requirements and technical requirements for each of the technology projects within the Program. These project level requirements will then be rolled-up into a Program Operational Requirements Document and Technical Requirements Document. This element will also coordinate and provide the information necessary for decision analysis and risk management.

5.1.4.5 *Total Vehicle Design and Integration*

The last 2 decades of design, manufacturing, and quality improvement initiatives, combined with low cost but ever increasing computing power, have led to total system design optimization technologies that have halved vehicle cost while exponentially increasing quality in the automotive industry. Design for lean thinking, six-sigma quality, modular manufacturing, economies of scale and supply chain optimization has progressed rapidly in many commercial product industries. Large commercial and defense airframers have started applying these rapidly emerging engineering principles to new products. The purpose of this element is to apply these total vehicle design and integration methodologies to a small aircraft and to produce an optimized vehicle system design that increases quality, reliability, safety, and affordability. The planned lean design approach will the latest design methods to the GA industry and provide building block designs that could mature to a full-scale aircraft demonstrations in the future.

5.1.4.6 *End-State Assessment Studies*

In order to provide the technical, policy, and economic basis for a national investment decision to develop a small aircraft transportation system it will be necessary to do more than demonstrate the technical feasibility of SATS. Many of the questions that will need to be answered before such a decision can be made will require an assessment of economic viability and the impact the end-state system will have on the environment (noise and emissions). This will necessitate studies that address market potential (or demand), system requirements and costs, capacity and its impact on other modes of transportation, and safety. The studies will utilize university and government expertise in multi-modal transportation analysis, market assessment and community acceptance, and will rely on industry partners to establish a firm understanding of the commercial potential.

6.0 Program Schedule

Program and Project milestones include exit criteria (deliverable products) and individually tailored metrics as part of the performance assessment process. The following sections contain specific milestones, descriptions, and exit criteria.

6.1 PROGRAM MILESTONES

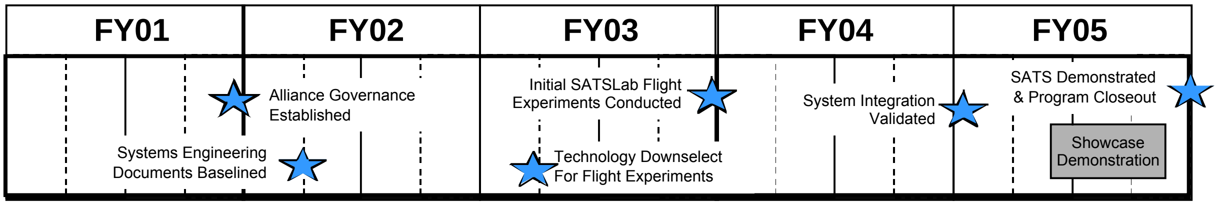

Figure 6.6.1 Program Milestones

Milestone/Description	Exit Criteria	QTR/FY
Alliance Governance Established: Establishment of alliance governance.	· Public-private interface established · Draft Business Operating Handbook · Alliance agreement signed · Implementation of co-located organizational structure	4th/01
Systems Engineering Documents Baselined: System Engineering documents for the 5 year program have been completed in baseline version and placed under configuration management.	· Operations Concept Document · Operational Requirements Document · Functional Architecture · Technical Requirements Document · Systems Engineering Management Plan · Master Schedule	1st/02
Technology Downselect For Flight Experiments: Select candidate technologies for experimental flight evaluation.	· Airborne Internet Architecture defined · Sequencing & separation algorithms chosen for flight evaluations · Flight deck technologies chosen for flight evaluations · FAA operational approval process completed for flight experiments	1st/03
Initial SATSLab Flight Experiments Conducted: Initial experimental flight evaluation of key enabling technologies conducted at regional SATSLab sites.	· Experimental airborne internet network deployed and operational · 4-D approaches conducted with dynamic approach paths · Low visibility landings conducted with integrated flight deck technologies · Conducted multi-aircraft operations in low visibility conditions in the terminal area	4th/03
System Integration Validated: Experimental validation of airborne systems with concept vehicle development complete.	· Integrated operating capabilities have been validated by flight and ground based experiments · The criteria of the Operational Requirements Document have been met	1st/05
SATS Demonstration & Program Closeout: Demonstrate the level to which the Small Aircraft Transportation System concept is feasible. Complete program documentation and closeout activities.	· Provide the technical, policy, and economic basis for national investment decisions to develop the Small Aircraft Transportation System concept including: – Complete a cost modeling analysis that validates affordability of concept. – Complete 2005 public demonstration of concept features and capabilities.	4th/05

	– Identify changes needed in regulations, certification procedures, and airport/airspace design to enable the concept. • Program documentation completed.	

Table 6.1 Program Milestone Descriptions and Exit Criteria

6.2 PROJECT MILESTONES

6.2.1 Virtual Visual Meteorological Conditions

6.2.2 High-Density Operations

6.2.3 Technology Integration and Proofs-of-Concept

6.2.4 Program Integration

7.0 Program Resources

7.1 FINANCIAL

7.2 WORKFORCE

7.3 FACILITIES

8.0 Controls

8.1 CONFIGURATION MANAGEMENT

8.2 DEVIATIONS AND WAIVERS

8.3 FINANCIAL METRICS

8.4 SCHEDULE METRICS

8.5 TECHNICAL METRICS

8.6 DE-SCOPE OPTIONS

9.0 Relationships to Other Programs and Agreements

10.0 Acquisition Strategy

11.0 Commercialization Opportunities

12.0 Risk Management

12.1 RISK MANAGEMENT STRUCTURE

12.2 RISK AREAS

13.0 Logistics

14.0 Test and Verification

15.0 Reviews

15.1 PROGRAM DOCUMENTATION

15.2 PROGRAM/PROJECT STATUS REPORTING

16.0 Tailoring

17.0 Change Log